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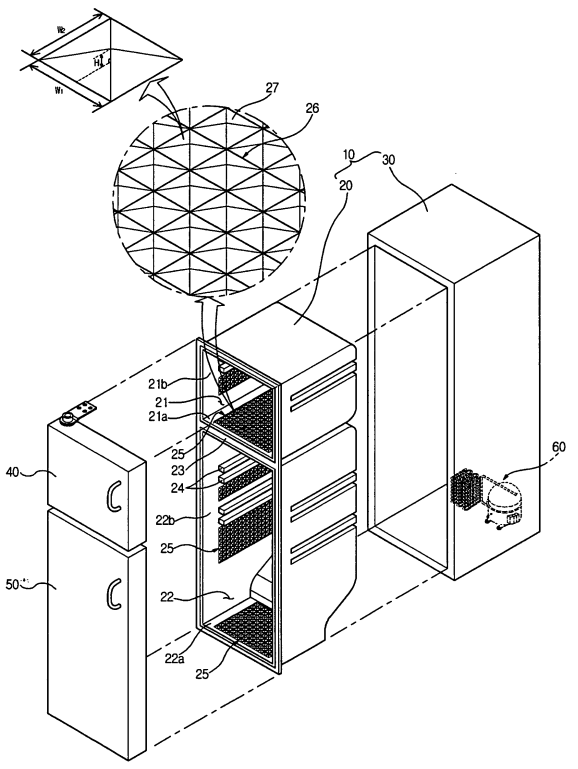
(54) Refrigerator and method of manufacturing inner case thereof

(57) A refrigerator having an inner case with increased strength and a method of manufacturing the same. The refrigerator includes a cooling system (60), a body (10) coupled to the cooling system (60), a door (40, 50) coupled to the body (10), and a plurality of reinforcing protrusions (26). The body (10) includes an outer case (30) encasing an inner body case (20) having a storage compartment (21, 22) defined therein. The door (40, 50) includes an outer door case encasing an inner door case. The door (40, 50) is coupled to the body (10) to provide access to the storage compartment (21, 22) which is cooled by the cooling system (60). The plurality of reinforcing protrusions (26) is disposed on at least one inner surface (21a, 21b, 22a, 22b) of either the inner body case (20) or the inner door case. The plurality of reinforcing protrusions (26) allows manufacturing thinner inner cases (20) for refrigerators that cannot be easily deformed and have a low product defect rate.

Fig.1



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Description

Field of the Invention

[0001] The present invention relates generally to the field of refrigerators and methods of manufacturing an inner case thereof. In particular, the present invention relates to a refrigerator having an inner case that is reinforced and a method of manufacturing the same.

Background of the Invention

[0002] Generally, a refrigerator includes a body having storage compartments, such as a refrigerating compartment to store food in a refrigerated state, and a freezing compartment to store food in a frozen state, doors coupled to the body to access the storage compartments, and a cooling system to cool the storage compartment.

[0003] The body includes an inner body case having at least one space necessary to form the storage compartment and an outer body case to surround the inner body case. The outer body case is preferably made of metal. When the inner body case is coupled with the outer body case, an insulation space is formed between the inner body case and the outer body case. The insulation space may be filled with an insulation material. The door typically includes an inner door case and an outer door case. An insulation material may fill the space between the inner door case and the outer door case. The cooling system usually includes a compressor and a heat exchanger. The cooling system is mounted in a machine room disposed at one side of the lower part of the body.

[0004] For a conventional refrigerator, during the primary and secondary molding of the inner body and door cases, the thickness of the inner body case and inner door case are often reduced at specific regions. As a result, the strength of the inner cases is reduced, leading to a higher product defect rate. Furthermore, when filling the space between the inner and outer cases, the thin parts of the inner cases may protrude away from the outer case due to the pressure of the filling, which leads to the deformation of the inner cases. Then, the entire body must be discarded. Also, attaching resin sheets to the thin parts of the inner cases or using thicker resin sheets for molding to increase the strength of the inner cases increases the production time and manufacturing costs.

Summary of the Invention

[0005] Therefore, it is an aspect of the invention to provide a refrigerator including an inner case which is thin and not easily deformed by way of an improvement to the structure of the inner case, and a method of manufacturing such an inner case.

[0006] In accordance with one aspect, the present invention provides a refrigerator comprising of: a cooling system; a body coupled to the cooling system, the body having an outer body case encasing an inner body case, the inner body case having a storage compartment defined therein cooled by the cooling system; a door coupled to the body providing access to the storage compartment, the door having an outer door case encasing an inner door case; and a plurality of reinforcing protrusions disposed on at least one surface of either the inner body case or the inner door case.

[0007] Preferably, each of the plurality of reinforcing protrusions is shaped as quadrangular pyramid with a substantially rectangular base.

[0008] Preferably, each reinforcing protrusion is disposed adjacent to each other to form a rectangular portion disposed on an inner surface of either the inner body case or inner door case.

[0009] Preferably, the plurality of reinforcing protrusions is disposed on a top surface, a bottom surface, a left side surface, a right side surface, and a rear surface of either the inner body case or the inner door case.

[0010] Preferably, each reinforcing protrusion is formed in the shape of a regular quadrangular pyramid, and each reinforcing protrusion has a height less than a length of the base of each reinforcing protrusion.

[0011] Preferably, the height of each reinforcing protrusion is approximately 1/10 of the length of the base of each reinforcing protrusion.

[0012] Preferably, the plurality of reinforcing protrusions is disposed on both inner body case and inner door case.

[0013] In accordance with another aspect, the present invention provides an inner case for a refrigerator comprising of: a plurality of sidewalls; a rear wall disposed adjacent to an edge of one of the sidewalls thereby defining a storage compartment, the storage compartment being enclosed with a door providing access to the storage compartment; and a means for reinforcing provided on at least one inner surface of the storage compartment.

[0014] Preferably, the means for reinforcing includes a plurality of reinforcing protrusions each shaped as a quadrangular pyramid with a substantially rectangular base.

[0015] Preferably, each of the plurality of reinforcing protrusions is disposed adjacent to each other to form a substantially rectangular portion disposed on an inner surface of the inner case. The plurality of reinforcing protrusions may be disposed on a top surface, a bottom surface, a left side surface, a right side surface, and a rear surface of the storage

compartment.

[0016] Preferably, each of the plurality of reinforcing protrusions is formed in the shape of a regular quadrangular pyramid having a substantially rectangular base and a height less than a length of the base.

[0017] Preferably, each of the plurality of reinforcing protrusions has a height approximately 1/10 of a length of the base.

[0018] In accordance with another aspect, the present invention provides a method of manufacturing an inner case for refrigerators, comprising of: (a) heating a resin sheet; (b) placing the heated resin sheet under an opening of a vacuum case; (c) evacuating an interior of the vacuum case to suction a portion of the resin sheet into the opening of the vacuum case so as to deform the resin sheet; (d) placing a mold having a shape corresponding to the inner case under the deformed resin sheet; (e) molding the deformed resin sheet by bringing together the vacuum case and the mold so that the deformed resin sheet contacts the mold to form an inner case preform having a storage compartment and a reinforcement including a plurality of reinforcing protrusions; (f) cooling the inner case preform; and (g) separating the inner case preform from the mold.

[0019] Preferably, each of the reinforcing protrusions is formed in the shape of a quadrangular pyramid with a substantially rectangular base.

[0020] Preferably, the reinforcing protrusions are formed adjacent to one another to form a substantially rectangular structure.

[0021] Preferably, each of the reinforcing protrusions is formed as a regular quadrangular pyramid with a height less than a length of the base of each reinforcing protrusion.

[0022] Preferably, each of the reinforcing protrusions is shaped as a quadrangular pyramid having a height approximately 1/10 of a length of the base.

[0023] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

Brief Description of the Drawings

[0024] A more complete appreciation of the invention and many of the aspects and advantages thereof will be readily obtained as the same becomes better understood by references to the following detailed description when considered in conjunction with the accompanying drawings, wherein:

FIG. 1 is an exploded, perspective view illustrating an inner body case for a refrigerator according to an embodiment of the present invention;

FIG. 2 is an exploded, perspective view illustrating an inner door case of a refrigerator according to an embodiment of the present invention;

FIGS. 3A to 3D are views illustrating a method of manufacturing an inner body case for a refrigerator according to an embodiment of the present invention;

FIG. 4 is a perspective view schematically illustrating a mold for molding the inner body case for a refrigerator according to the embodiment of the present invention; and

FIGS. 5 and 6 are graphs illustrating improved effects of the inner case for a refrigerator according to the embodiment of the present invention.

Detailed Description of the Invention

[0025] Reference will now be made in detail to the embodiment of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiment is described below to explain the present invention by referring to the figures.

[0026] FIG 1 is an exploded perspective view illustrating a refrigerator according to an embodiment of the present invention. The refrigerator may include a body 10, two doors 40 and 50 coupled to the body 10, and a cooling system 60 mounted in the body 10.

[0027] The body 10 may include an inner body case 20 and an outer body case 30 surrounding the inner body case 20. The inner body case 20 is preferably made of resin having high impact resistance and high heat resistance, such as an ABS resin. The outer body case 30 is preferably made of metal.

[0028] The inner body case 20 is partitioned into a freezing compartment 21 and a refrigerating compartment by a partition 23. Guide rails 24, to which shelves (not shown) may be coupled, are disposed on left side surfaces 21b and 22b and right side surfaces (not shown) of the freezing compartment 21 and the refrigerating compartment 22. Reinforcements 25 are disposed on an inner surface of the inner body case 20. The reinforcements 25 may be disposed on top surfaces (not shown), bottom surfaces 21a and 22a, the left side surfaces 21b and 22b, the right side surfaces (not shown), and rear surfaces (not shown).

[0029] The reinforcements 25 increase the strength of the inner body case 20 to prevent deformation of the inner body

case 20. The reinforcements 25 are preferably a rectangular portion composed of a plurality of reinforcing protrusions 26 disposed adjacent to one another. Each reinforcing protrusion 26 is preferably formed in the shape of a quadrangular pyramid having four triangular faces 27 which are inclined upward to converge on the vertex of the pyramid. Preferably, each reinforcing protrusion 26 has the same base widths W1 and W2. The reinforcing protrusion 26 has a height H less than the widths W1 and W2. More preferably, the height H of each reinforcing protrusion 26 is 1/10 of the widths W1 and W2. In one embodiment, the widths W1 and W2 of each reinforcing protrusion 26 is 10 mm.

[0030] However, the reinforcing protrusions 26 constituting the reinforcements 25 are not restricted to the illustrated and described structure. For example, the base widths W1 and W2 of the reinforcing protrusion 26 may be different from each other. The height H of the reinforcing protrusion 26 may be greater or less than 1/10 of the base width W1 and W2.

[0031] FIG 2 is an exploded perspective view schematically illustrating the door 40 of the refrigerator according to the present invention.

[0032] As shown in FIG 2, the door 40 includes an inner door case 41 and an outer door case 42. The inner door case 41 is preferably made of resin. The outer door case 42 is preferably made of metal, as in the body 10.

[0033] As seen in FIG 2, reinforcements 43 are disposed on inner surfaces of the inner door case 41. Reinforcements 43 may be disposed on a top surface (not shown), a bottom surface 41a, a left side surface 41b, a right side surface (not shown), and a rear surface 41c. A plurality of reinforcing protrusions 44 constitutes each reinforcement 43. Each reinforcing protrusion 44 may be formed in the shape of the same quadrangular pyramid as the reinforcing protrusions 26 of the inner body case 20.

[0034] The reinforcing protrusions 44 constituting the reinforcements 43 are not restricted to the illustrated and described structure. For example, the base width W1 and W2 of the reinforcing protrusions 44 may be different from each other. The height H of the reinforcing protrusions 44 may be greater or less than 1/10 of the base width W1 and W2.

[0035] Hereinafter, a method of manufacturing the inner body case 20 of the refrigerator according to the present invention will be described with reference to FIGS. 3A to 4.

[0036] The method of manufacturing the inner body case 20 comprises seven operations. First operation is heating. As shown in FIG. 3A, a resin sheet 70 is heated by a heater 110, while the resin sheet 70 is held by a jig 120, such that the resin sheet 70 can be easily deformed.

[0037] Second, as shown in FIG 3B, the heated resin sheet 70 is placed under a vacuum case 130 having a molding space 131.

[0038] Third, the interior of the vacuum case 130 is evacuated such that a portion of the heated resin sheet 70 is suctioned into the vacuum space 131. As a result, the resin sheet 70 deforms into two volumes which will correspond to the freezing compartment 21 and the refrigerating compartment 22. In this way, the resin sheet 70 is primarily molded.

[0039] Fourth, a mold 140 having a shape corresponding to the inner body case 20 is placed under the deformed resin sheet 70.

[0040] Fifth, as shown in FIG 3C, the vacuum case 130 and the mold 140 are brought together such that the open bottom of the vacuum case 130 is covered by the mold 140. Then high-pressure air is blown into the vacuum case 130. As a result, the resin sheet 70 is brought into tight contact with the mold 140.

[0041] As shown in FIG 3D, an inner case preform 75 is produced. The inner case preform 75 has the freezing compartment 21, the refrigerating compartment 22, and the reinforcements 25. Next, the inner case preform 75 is cooled.

[0042] Finally, the inner case preform 75 is separated from the mold 140. Although not shown in the drawing, unnecessary portions are removed from the inner case preform 75, and grooves necessary for assembly are formed in the inner case preform 75.

[0043] As shown in FIG 4, the mold 140 used in the molding operation of the inner body case manufacturing method includes two molding parts: a freezing compartment molding part 141 and a refrigerating compartment molding part 142. The freezing compartment molding part 141 and the refrigerating compartment molding part 142 have elongate grooves 143 to form the guide rails 24 and concave-convex parts 144 to form the reinforcements 25.

[0044] Each concave-convex part 144 may include a plurality of protrusion forming grooves 145, which correspond to the reinforcing protrusions 26 (see FIG 1), disposed adjacent to each other to form a substantially rectangular portion. Preferably, each protrusion forming groove 145 has horizontal and vertical widths of 10 mm and a depth of 1 mm, which is 1/10 of the horizontal and vertical widths. Consequently, when the heated resin sheet 70 is brought into tight contact with the mold 140 in the molding operation, reinforcements 25 are formed on the resin sheet 70. Also, each reinforcement 25 includes the plurality of reinforcing protrusions 26 having base widths W1 and W2 of 10 mm and height H of 1 mm.

[0045] The inner door case 41 is manufactured by the same method as the inner body case 20 manufacturing method. Although, in this case, a mold constructed in a shape corresponding to the shape of the door and having concave-convex parts is used in the molding operation.

Table 1 (MD: Main Direction, TD: Tangential Direction)

	Common resin sheet		Resin sheet with reinforcements		Difference		Remark
	MD	TD	MD	TD	MD	TD	
Bending strength (kg/mm^2)	8.83	6.86	12.53	12.42	3.7↑ (41.9%)	5.56↑ (81.04%)	41-81% improved
Bending coefficient (kg/mm^2)	269.41	244.72	475.45	471.65	206.04↑ (76.04%)	226.93↑ (92.73%)	76-92% improved

[0046] Table 1 compares the strength of a common resin sheet without reinforcements 25 or 43 and a resin sheet with reinforcements 25 or 43. When reinforcements 25 or 43, each including the plurality of reinforcing protrusions 26 or 44, are formed on the common resin sheet, the bending strength of the common resin sheet is improved by at least 41 %.

[0047] Consequently, the strength of the inner body case 20 and inner door case 41 of the refrigerator according to the present invention is greater than that of the inner cases of conventional refrigerators. Therefore, the inner body case 20 or inner door case 41 of the refrigerator according to the present invention is not easily deformed.

[0048] Furthermore, when the reinforcements 25 and 43, each including the plurality of reinforcing protrusions 26 and 44, are formed at the inner body case 20 and inner door case 41, it is possible to reduce the thickness of the inner cases 20 and 41 and to reduce the product defect rate. Specifically, as shown in FIGS. 5 and 6, as the thickness of the inner body case 20 and inner door case 41 is reduced from 4 mm to 3.6 mm, i.e., approximately by 10%, the product defect rate is reduced from 5% to 2%. Consequently, manufacturing costs are reduced, and product quality is improved.

[0049] As apparent from the above description, reinforcements each including a plurality of reinforcing protrusions are formed at inner surfaces of inner body and door cases. Consequently, it is possible to manufacture thinner inner cases for refrigerators which are not easily deformed and have a low defective product rate. Therefore, it is possible to reduce the manufacturing costs of the refrigerators and improve the reliability of products.

[0050] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A refrigerator comprising of:

a cooling system;
a body coupled to the cooling system, the body having an outer body case encasing an inner body case, the inner body case having a storage compartment defined therein cooled by the cooling system;
a door coupled to the body providing access to the storage compartment, the door having an outer door case encasing an inner door case; and
a plurality of reinforcing protrusions disposed on at least one inner surface of either the inner body case or the inner door case.

2. A refrigerator according to claim 1, wherein each of the plurality of reinforcing protrusions is shaped as quadrangular pyramid with a substantially rectangular base.

3. A refrigerator according to claim 1, wherein each of the plurality of reinforcing protrusions are disposed adjacent to each other to form a substantially rectangular portion disposed on an inner surface of either the inner body case or the inner door case.

4. A refrigerator according to claim 3, wherein the plurality of reinforcing protrusions is disposed on a top surface, a bottom surface, a left side surface, a right side surface, and a rear surface of either the inner body case or the inner door case.

5. A refrigerator according to claim 1, wherein each of the plurality of reinforcing protrusions is formed in the shape of a regular quadrangular pyramid having a substantially rectangular base and a height less than a length of the base.

6. A refrigerator according to claim 5, wherein each of the plurality of reinforcing protrusions has a height approximately 1/10 of the length of the base.

7. A refrigerator according to claim 1, wherein the plurality of reinforcing protrusions are disposed on both the inner body case and the inner door case.

8. An inner case for a refrigerator comprising of:

a plurality of sidewalls;
a rear wall disposed adjacent to an edge of one of the sidewalls thereby defining a storage compartment, the storage compartment being enclosed with a door providing access to the storage compartment; and
a means for reinforcing the storage compartment provided on at least one inner surface of the storage com-

partment.

9. An inner case for a refrigerator according to claim 8, wherein the means for reinforcing includes a plurality of reinforcing protrusions each shaped as a quadrangular pyramid with a substantially rectangular base.

10. An inner case for a refrigerator according to claim 9, wherein each of the plurality of reinforcing protrusions are disposed adjacent to each other to form a substantially rectangular portion disposed on an inner surface of the inner case.

11. An inner case for a refrigerator according to claim 10, wherein the plurality of reinforcing protrusions are disposed on a top surface, a bottom surface, a left side surface, a right side surface, and a rear surface of the storage compartment.

12. An inner case for a refrigerator according to claim 9, wherein each of the plurality of reinforcing protrusions is formed in the shape of a regular quadrangular pyramid having a substantially rectangular base and a height less than a length of the base.

13. An inner case for a refrigerator according to claim 12, wherein each of the plurality of reinforcing protrusions has a height approximately 1/10 of a length of the base.

14. A method of manufacturing an inner case for refrigerators, comprising:

(a) heating a resin sheet;
(b) placing the heated resin sheet under an opening of a vacuum case;
(c) evacuating an interior of the vacuum case to suction a portion of the resin sheet into the opening of the vacuum case so as to deform the resin sheet;
(d) placing a mold having a shape corresponding to the inner case under the deformed resin sheet;
(e) molding the deformed resin sheet by bringing together the vacuum case and the mold so that the deformed resin sheet contacts the mold to form an inner case preform having a storage compartment and a reinforcement including a plurality of reinforcing protrusions;
(f) cooling the inner case preform; and
(g) separating the inner case preform from the mold.

15. A method according to claim 14, further comprising the step of forming each of the reinforcing protrusions in the shape of a quadrangular pyramid with a substantially rectangular base.

16. A method according to claim 14, further comprising the step of forming each of the reinforcing protrusions adjacent to one another to form a substantially rectangular structure.

17. A method according to claim 14, further comprising the step of forming each of the reinforcing protrusions as a regular quadrangular pyramid with a substantially rectangular base and a height less than a length of the base.

18. A method according to claim 17, further comprising the step of forming each of the reinforcing protrusions shaped as a quadrangular pyramid having a height approximately 1/10 of a length of the base.

Fig.1

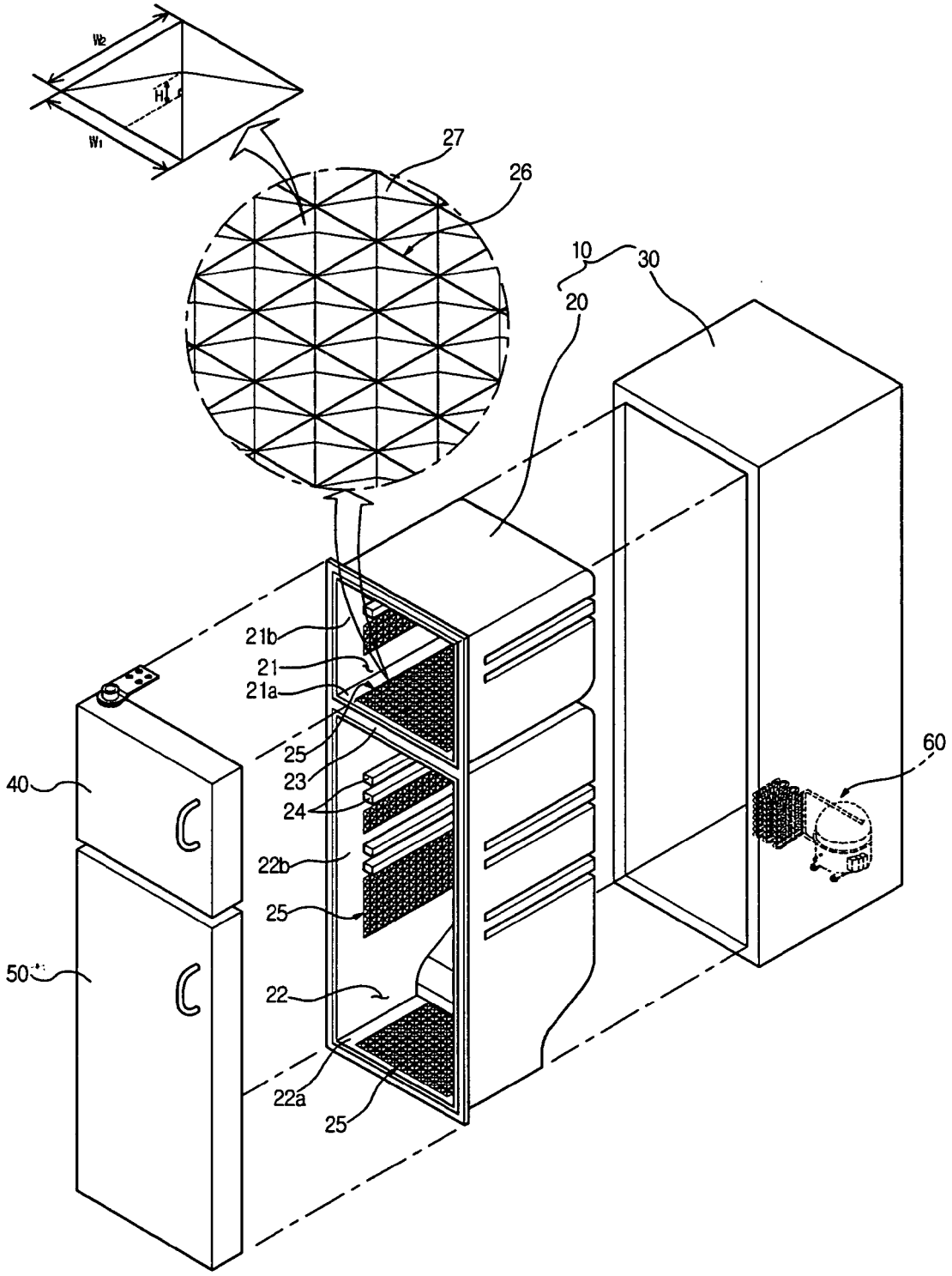


Fig.2

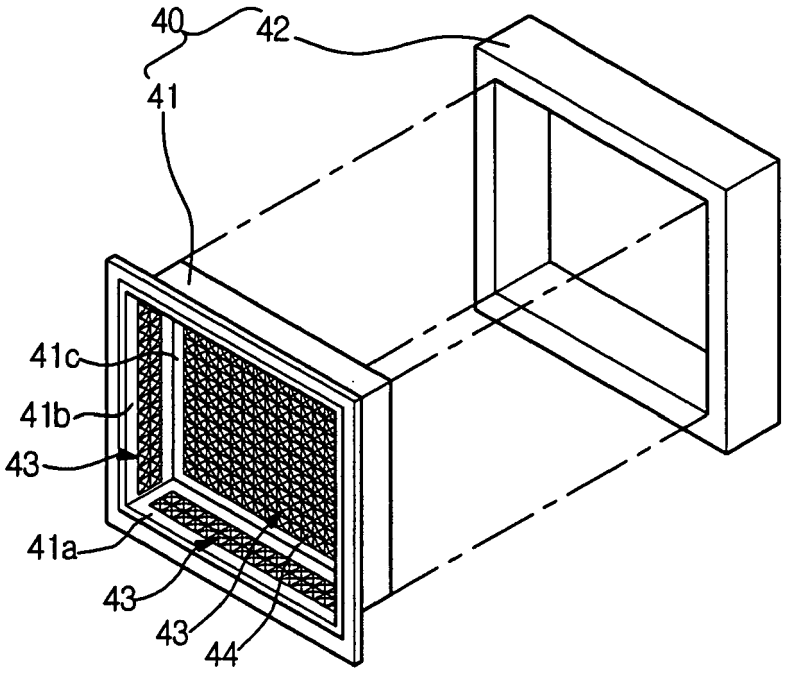


Fig.3a

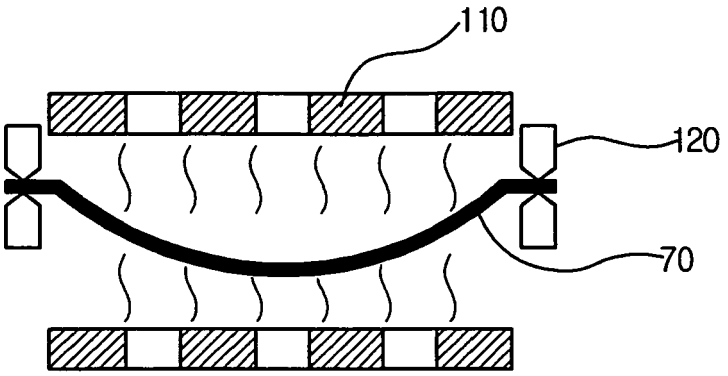


Fig.3b

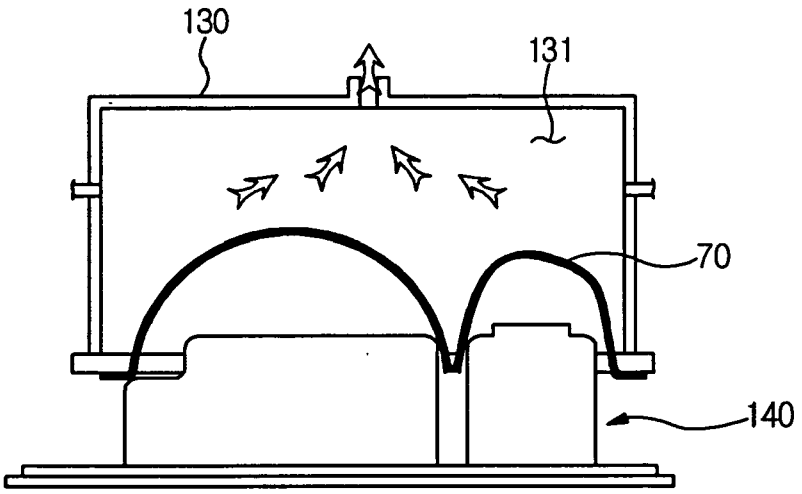


Fig.3c

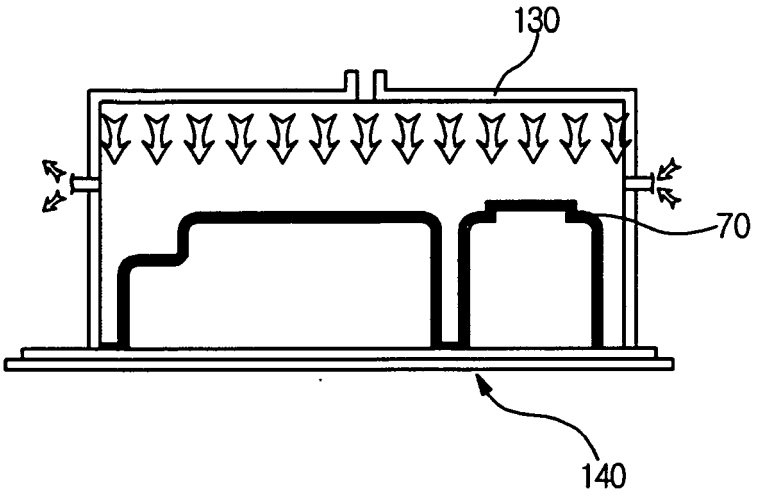


Fig.3d

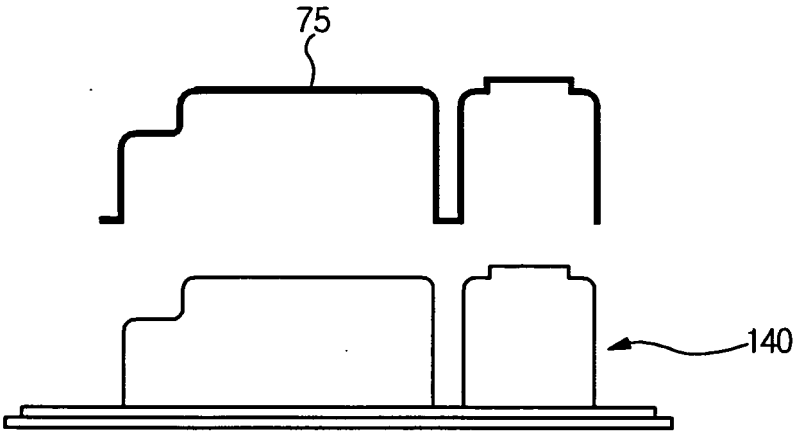


Fig.4

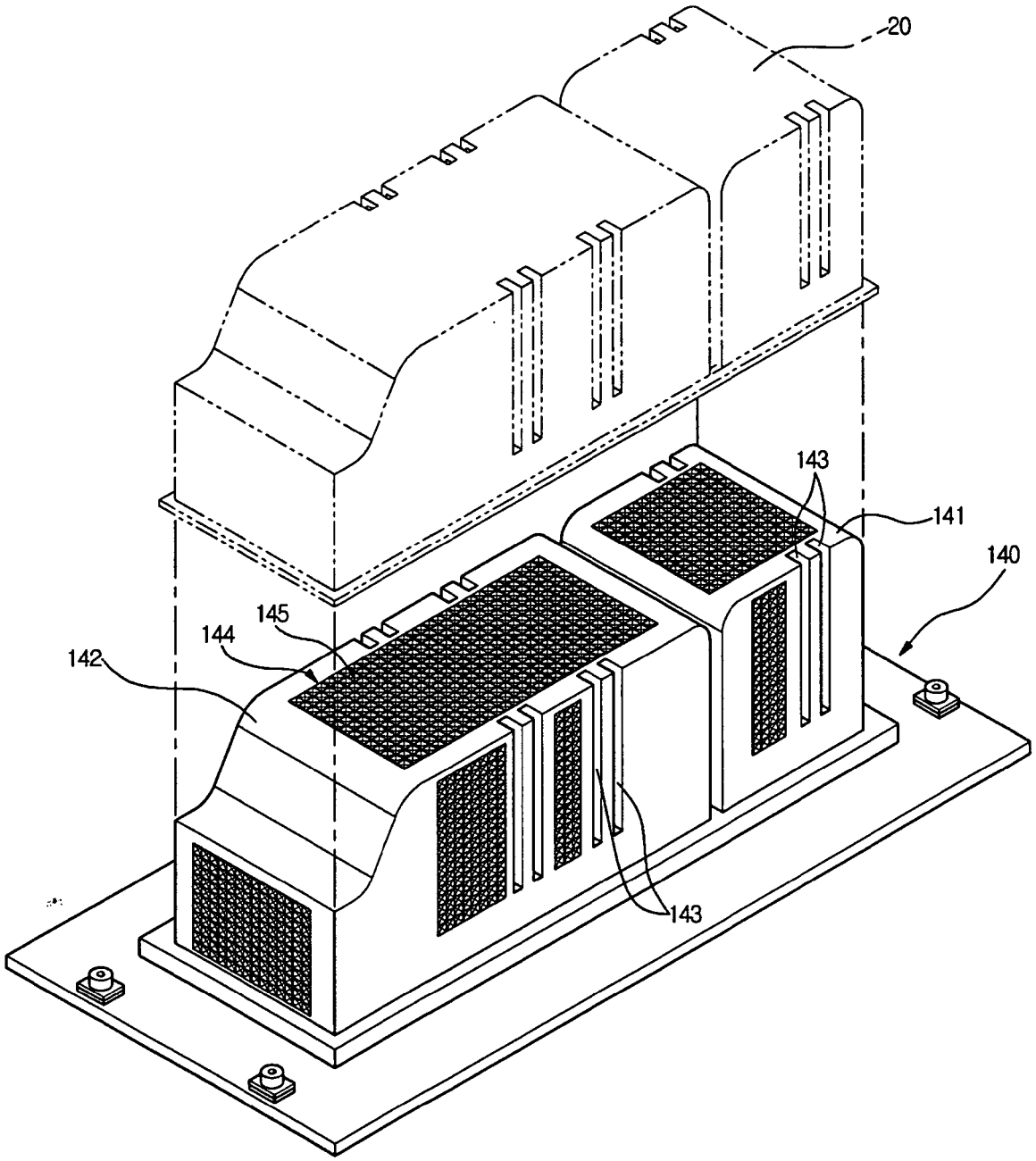


Fig.5

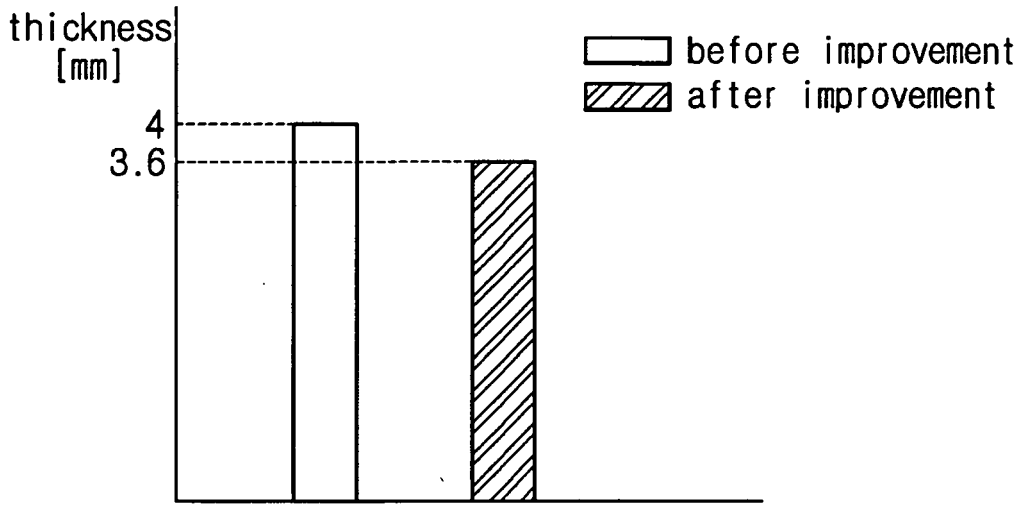
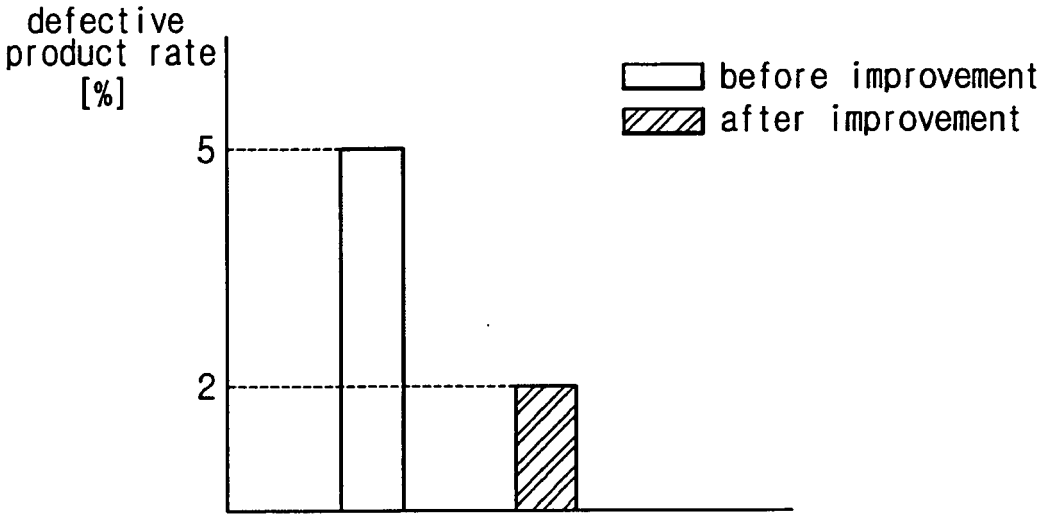


Fig.6


defective
product rate
[%]
5
2
before improvement
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